

110 學年度四技二專第一次聯合模擬考試

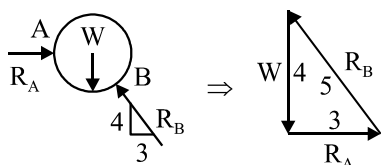
土木與建築群 專業科目(一) 詳解

110-1-06-4

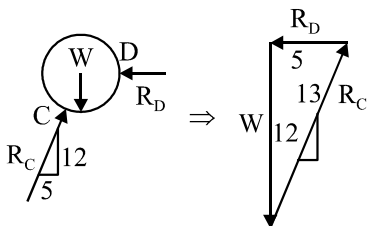
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
B	B	B	C	D	D	A	A	C	B	C	C	A	D	D	C	A	B	D	A
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
D	A	C	C	B	A	A	B	D	B	C	D	D	A	B	C	A	B	C	D

第一部分：基礎工程力學

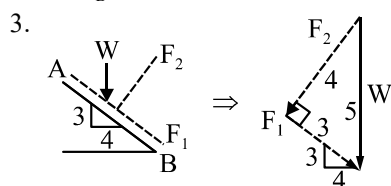
- (B) 當一物體受他物體之作用力時，必產生一反作用力，且作用力與反作用力大小相等，方向相反且在同一直線之不同物體上，故撐竿跳是靠地面之反作用力
- 取自由體圖進行探討



$$\frac{W}{4} = \frac{R_A}{3} = \frac{R_B}{5} \quad \therefore R_A = \frac{3}{4}W, \quad R_B = \frac{5}{4}W$$

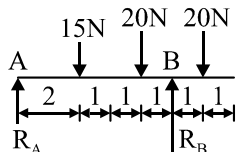


$$\frac{W}{12} = \frac{R_D}{5} = \frac{R_C}{13} \quad \therefore R_C = \frac{13}{12}W, \quad R_D = \frac{5}{12}W$$

故 R_B 承受最大反力 F_1 為沿屋頂斜面 AB， F_2 為垂直屋頂斜面 AB

$$\frac{F_1}{3} = \frac{F_2}{4} = \frac{W}{5} \quad \therefore F_1 = \frac{3}{5}W, \quad F_2 = \frac{4}{5}W$$

- 將均佈荷重及均變荷重簡化為集中荷重作用於重心位置，並取其自由體圖探討



$$+\circlearrowleft \Sigma M_A = 0$$

$$15 \times 2 + 20 \times 4 + 20 \times 6 - R_B \times 5 = 0 \quad \therefore R_B = 46 \text{ N}(\uparrow)$$

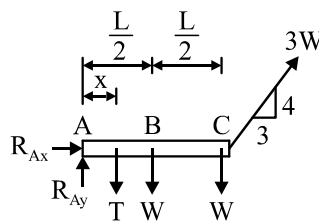
$$+\uparrow \Sigma F_y = 0, \quad R_A + R_B - 55 = 0 \quad \therefore R_A = 9 \text{ N}(\uparrow)$$

- 合力為 $10 \text{ N}(\searrow)$

$$+\circlearrowleft \Sigma M_D = 10 \times 0.6 - 6 \times 0.5 - 5 \times 0.4 = 10 \cdot x$$

$$\therefore x = 0.1 \text{ m} = 10 \text{ cm}$$

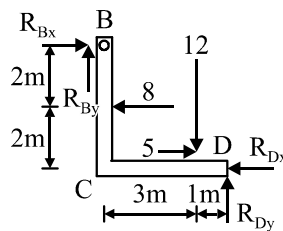
- 力偶不能用一單力平衡，必須用一反向力偶來平衡
- 取 ABC 樑自由體圖討論



$$+\circlearrowleft \Sigma M_A = 0$$

$$T(x) + W\left(\frac{L}{2}\right) + W(L) - \left(\frac{4}{5} \cdot 3W\right)(L) = 0 \quad \therefore x = \frac{9WL}{10T}$$

- (1) B 為鉸接，取 BCD 樑自由體圖討論，且將均佈荷重轉化為集中荷重

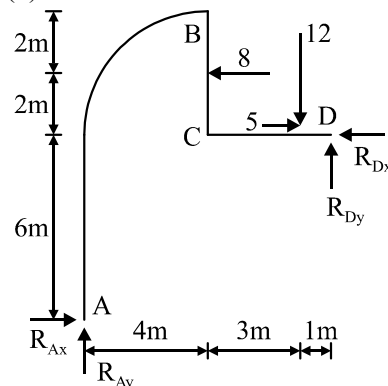


$$+\circlearrowleft \Sigma M_B = 0$$

$$8 \times 2 + 12 \times 3 - 5 \times 4 - R_{Dy}(4) + R_{Dx}(4) = 0$$

$$\Rightarrow R_{Dx} - R_{Dy} = -8 \cdots \cdots \textcircled{1}$$

- (2) 取全體構件自由體圖討論



$$+\circlearrowleft \Sigma M_A = 0$$

$$-8 \times 8 + 12 \times 7 + 5 \times 6 - R_{Dx}(6) - R_{Dy}(8) = 0$$

$$\Rightarrow 3R_{Dx} + 4R_{Dy} = 25 \cdots \cdots \textcircled{2}$$

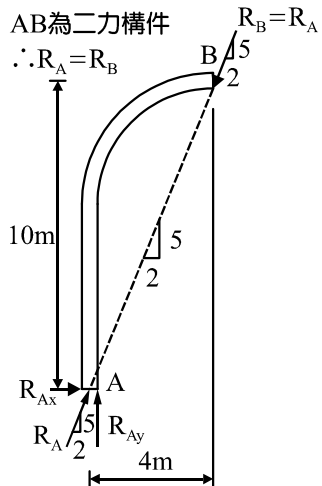
$$\text{取 } \textcircled{1} \textcircled{2} \text{ 式聯立得 } R_{Dx} = 1 \text{ N}(\rightarrow), \quad R_{Dy} = 7 \text{ N}(\uparrow)$$

$$\begin{aligned} +\rightarrow \Sigma F_x = 0, & R_{Ax} - 8 + 5 + 1 = 0 \quad \therefore R_{Ax} = 2 \text{ N}(\rightarrow) \\ +\uparrow \Sigma F_y = 0, & R_{Ay} - 12 + 7 = 0 \quad \therefore R_{Ay} = 5 \text{ N}(\uparrow) \end{aligned}$$

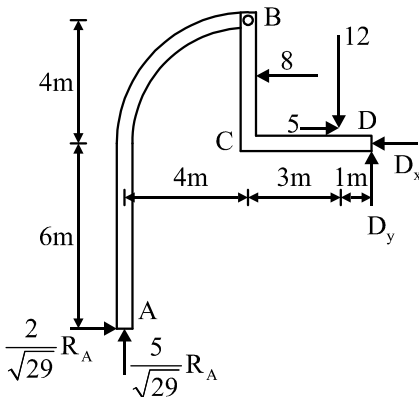
[另解]

AB 為二力構件， R_A 必經過 B 點，由 AB 桿自由體

圖，可知 R_A 受力方向為 $\left(\frac{5}{2}\right)$

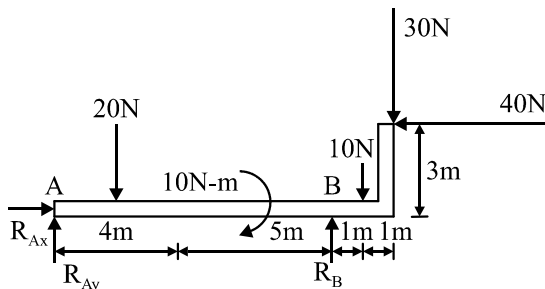


將 R_A 受力分解後並取整體自由體圖討論如下



$$\begin{aligned} +\curvearrowright \Sigma M_D = 0 \\ \frac{5}{\sqrt{29}} R_A \times 8 - \frac{2}{\sqrt{29}} R_A \times 6 - 8 \times 2 - 12 \times 1 = 0 \\ \frac{40}{\sqrt{29}} R_A - \frac{12}{\sqrt{29}} R_A = 28, \quad \frac{28}{\sqrt{29}} R_A = 28, \quad R_A = \sqrt{29} \\ R_{Ax} = \frac{2}{\sqrt{29}} R_A = \frac{2}{\sqrt{29}} (\sqrt{29}) = 2 \text{ N}(\rightarrow) \\ R_{Ay} = \frac{5}{\sqrt{29}} R_A = \frac{5}{\sqrt{29}} (\sqrt{29}) = 5 \text{ N}(\uparrow) \end{aligned}$$

9.



將均佈荷重轉化為集中荷重，作用於其重心位置，並將傾斜外力分解標示於圖上

$$\begin{aligned} +\curvearrowright \Sigma M_A = 0 \\ 20 \times 2 + 10 - R_B \times 9 + 10 \times 10 + 30 \times 11 - 40 \times 3 = 0 \\ \therefore R_B = 40 \text{ N}(\uparrow) \end{aligned}$$

10. 由圖判讀 A(1, 4, 0) 及 B(7, 1, 2) 座標

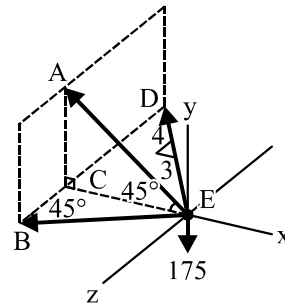
$$\overrightarrow{AB} = \langle 7-1, 1-4, 2-0 \rangle = \langle 6, -3, 2 \rangle$$

$$\vec{F} = 210 \times \frac{\langle 6, -3, 2 \rangle}{\sqrt{6^2 + (-3)^2 + 2^2}} = \langle 180, -90, 60 \rangle \text{ N}$$

$$\vec{F} + \vec{P} = 0 \text{ (合力為零，則平衡)}$$

$$\text{故 } \vec{P} = \langle -180, 90, -60 \rangle \text{ N}$$

12.



$$+\uparrow \Sigma F_y = 0, \quad S_{EA} \left(\frac{1}{\sqrt{2}} \right) - 175 = 0$$

$$\therefore S_{EA} = 175\sqrt{2} \text{ N}$$

$$+\curvearrowright \Sigma F_z = 0, \quad S_{EB} \left(\frac{1}{\sqrt{2}} \right) - S_{ED} \left(\frac{4}{5} \right) = 0 \dots\dots ①$$

$$+\rightarrow \Sigma F_x = 0, \quad S_{EA} \left(\frac{1}{\sqrt{2}} \right) + S_{EB} \left(\frac{1}{\sqrt{2}} \right) + S_{ED} \left(\frac{3}{5} \right) = 0$$

$$\Rightarrow S_{EB} \left(\frac{1}{\sqrt{2}} \right) + S_{ED} \left(\frac{3}{5} \right) = -175 \dots\dots ②$$

$$\text{由①②式得 } S_{EB} = -100\sqrt{2} \text{ N}, \quad S_{ED} = -125 \text{ N}$$

13. 由圖判讀獲知兩力偶矩

$$\text{分別為 } C_{x1} = -6 \text{ N} \cdot \text{m} = -6 \text{ N} \cdot \text{m}$$

$$\text{及 } C_{z1} = 4 \text{ N} \cdot 2 \text{ m} = 8 \text{ N} \cdot \text{m}$$

將 F 力分解說明如下

$$A(0, 0, 6) \text{ m}, \quad B(3, 2, 0) \text{ m}$$

$$\overrightarrow{AB} = \langle 3-0, 2-0, 0-6 \rangle = \langle 3, 2, -6 \rangle \text{ m}$$

$$\vec{F} = 21 \times \frac{\langle 3, 2, -6 \rangle}{\sqrt{3^2 + 2^2 + (-6)^2}} = \langle 9, 6, -18 \rangle \text{ N}$$

力分解作用於 A 點(0, 0, 6)

$$C_{x2} = 6 \times (-6) = -36 \text{ N} \cdot \text{m}$$

$$C_{y2} = 9 \times 6 = 54 \text{ N} \cdot \text{m}$$

$$C_{z2} = 0$$

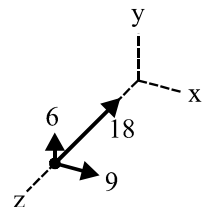
由 F 及兩力偶矩所得

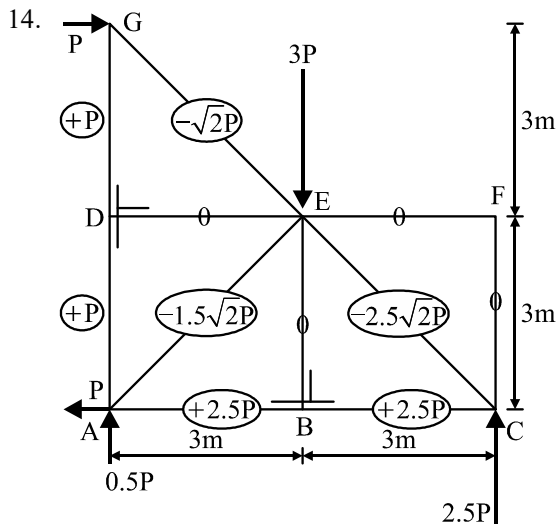
$$C_x = (-6) + (-36) = -42 \text{ N} \cdot \text{m}$$

$$C_y = 54 \text{ N} \cdot \text{m}$$

$$C_z = 8 \text{ N} \cdot \text{m}$$

$$\text{合力偶矩為 } \sqrt{(-42)^2 + 54^2 + 8^2} = \sqrt{4744} \text{ N} \cdot \text{m}$$





(1) 計算反力 $\rightarrow \Sigma F_x = 0 \Rightarrow A_x = P (\leftarrow)$

$+\circlearrowleft \Sigma M_A = 0$

$$P(6) + 3P(3) - C_y(6) = 0 \quad \therefore C_y = 2.5P (\uparrow)$$

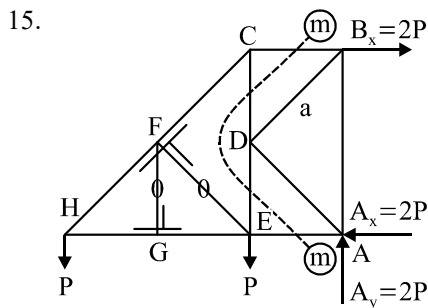
$$\rightarrow \Sigma F_y = 0 \Rightarrow A_y = 0.5P (\uparrow)$$

(2) 判斷零桿，並標示於自由體圖上

(3) 利用遠離節點為拉力，標示為「+」，利用指向節點為壓力，標示為「-」

並配合節點法，解出各桿件內力

得零桿有 4 根，拉力桿有 4 根，壓力桿有 3 根



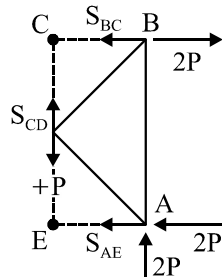
(1) $+\circlearrowleft \Sigma M_A = 0$

$$B_x(4) - P(6) - P(2) = 0 \quad \therefore B_x = 2P (\rightarrow)$$

$$\rightarrow \Sigma F_x = 0 \quad \therefore A_x = 2P (\leftarrow)$$

(2) 由圖形判斷得 S_{FG} 及 $S_{EF} = 0$ ，進而獲知 $S_{DE} = +P$

(3) 取 (m)-(m) 斷面右側自由體圖討論

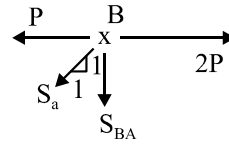


$+\circlearrowleft \Sigma M_E = 0$

$$2P(4) - S_{BC}(4) - 2P(2) = 0 \quad \therefore S_{BC} = +P$$

$$\rightarrow \Sigma F_x = 0, \text{ 得 } S_{AE} = -P$$

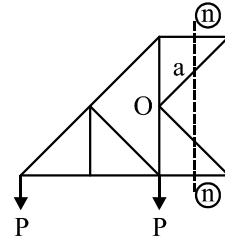
(4) 取 B 點自由體圖討論



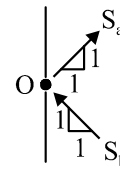
$$\rightarrow \Sigma F_x = 0, \quad 2P - S_a\left(\frac{1}{\sqrt{2}}\right) - P = 0 \quad \therefore S_a = +\sqrt{2}P$$

[另解]

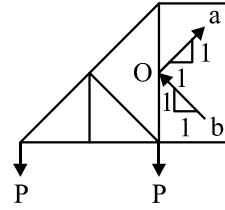
(1) 取 (n)-(n) 斷面左側自由體圖討論



(2) 取節點 O 進行討論， $\rightarrow \Sigma F_x = 0$ ，則 $S_a = S_b$



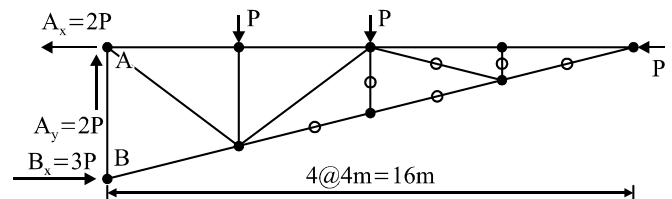
(3) 取左側自由體討論



$$+\uparrow \Sigma F_y = 0, \quad S_a \times \frac{1}{\sqrt{2}} \times 2 - 2P = 0$$

$$\therefore S_a = +\sqrt{2}P = \sqrt{2}P(T)$$

16. 取平面桁架自由體圖討論



$$+\uparrow \Sigma F_y = 0, \quad A_y - 2P = 0 \quad \therefore A_y = 2P (\uparrow)$$

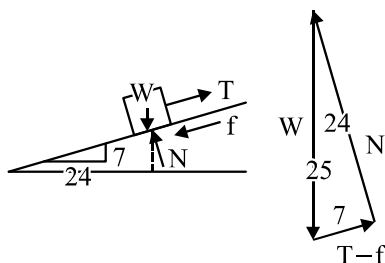
$+\circlearrowleft \Sigma M_A = 0$

$$P(4) + P(8) - B_x(4) = 0 \quad \therefore B_x = 3P (\rightarrow)$$

$$\rightarrow \Sigma F_x = 0, \quad B_x - P - A_x = 0 \quad \therefore A_x = 2P (\leftarrow)$$

共有 6 根零桿件

18. 取自由體圖討論



$$\frac{W}{25} = \frac{N}{24} = \frac{T-f}{7} \quad \therefore N = \frac{24}{25} \times 100 = 96 \text{ kgf}$$

$$f = \mu \cdot N = (0.2)(96) = 19.2 \text{ kgf}, \quad T-f = \frac{7}{25} W$$

$$\therefore T = \frac{7}{25} W + f = \frac{7}{25}(100) + 19.2 = 47.2 \text{ kgf}$$

19. (1) 取 B 自由體圖討論

$$N_B = 42, \quad f_B = 0.3 \times 42 = 12.6 \text{ kgf}$$

且外力 $\leq 12.6 \text{ kgf}$

未超過最大靜摩擦力，故 f_B 採 8.4 kgf

(2) 取 A 物體自由體圖討論

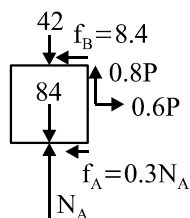
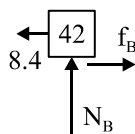
$$+\uparrow \Sigma F_y = 0$$

$$N_A + 0.8P - 42 - 84 = 0 \cdots \cdots \textcircled{1}$$

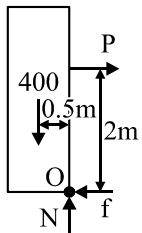
$$+\rightarrow \Sigma F_x = 0, \quad 0.6P - f_A - f_B = 0$$

$$\Rightarrow 0.6P - 0.3N_A - 8.4 = 0 \cdots \cdots \textcircled{2}$$

由①②式聯立得 $P = 55 \text{ kgf}$



20.



(1) 滑動行為討論

$$N = 400 \text{ kgf}, \quad f = \mu \cdot N = 400 \times 0.2 = 80 \text{ kgf}$$

外力 $P = 95 \text{ kgf}$ ，故物體產生滑動

(2) 傾倒行為討論

$$+\curvearrowright \Sigma M_O, \quad 95 \times 2 - 400 \times 0.5 = -20 = 20 \text{ kgf} \cdot \text{m} (\curvearrowright)$$

故物體不產生傾倒行為

[另解]

(1) 欲使物體產生滑動所需的 P

$$N = 400 \text{ kgf}, \quad f = \mu \cdot N = 400 \times 0.2 = 80 \text{ kgf}$$

$$+\rightarrow \Sigma F_x = 0, \quad P - f = 0 \quad \therefore P = 80 \text{ kgf}$$

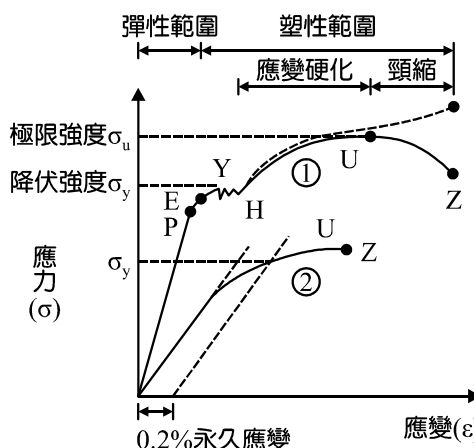
(2) 欲使物體傾倒所需的 P

$$+\curvearrowright \Sigma M_O = 0, \quad P \times 2 - 400 \times 0.5 = 0 \quad \therefore P = 100 \text{ kgf}$$

故，當 $P = 95 \text{ kgf}$ 時，物體為滑動但不傾倒

第二部分：材料與試驗

21.



22. (B) 材料 B 受熱時單位長度的變化量大於 A

(C) 材料 A 的傳熱效果較材料 B 來得佳

(D) 防火材料應選擇熱傳導係數較小者

23. (C) HCN(氰化氫)、CO、CO₂、H₂CO₃(碳酸)等碳化化合物屬於無機材料

24. (A) 無收縮水泥屬於特殊水泥

(B) 依照公共工程委員會第 03601 章無收縮水泥砂漿中規定，無收縮水泥砂漿不得有收縮作用(即收縮率為 0%)

(D) 無收縮水泥砂漿灌注完成後必須搗實，所含之空氣必須設法排除

25. (B) C₄AF 的早期與長期強度均低，但可抵抗硫酸鹽侵蝕

26. 製作水泥抗壓強度試驗體時，應採用試體模為 5 cm × 5 cm × 5 cm 之正立方體，並先以流度台試驗測出拌合水量(為標準流度值為 100~115%之水量)後，再將水泥與標準砂(美國伊利諾州之渥太華天然砂)拌合成水泥砂漿，且應依照 1 : 2.75 重量比配置，且各型水泥的強度發展於齡期 90 天時會大致相同

28. (B) CNS 61 規定水泥中氧化鎂含量不得大於 6%

29. (A) 標準稠度 ⇔ 費開針試驗

(B) 健性 ⇔ 浸水法、煮沸法、李氏健性膨脹器、增壓鍋法

(C) 細度 ⇔ 水泥篩析法、華格納氏濁度計、布蘭氏計透儀、風分機法

$$30. \frac{W}{300 \sim 325} = 0.532 \Rightarrow W = 160 \sim 173 \text{ kg}$$

32. (D) 實施細粒料篩分析時，應將篩號較小者安置於上方並依照篩號小到由上而下依序放置，如 #4、#8、#16、#30、#50、#100

33. (D) 鋼筋混凝土之單位重約為 2400 kgf/m³

35. (B) 石灰岩的主要成分為碳酸鈣，但因碳酸鈣容易遭水分和 CO₂ 侵蝕而溶解，因此其抗酸性弱，耐久差

36. (C) 室外石材為防止風化，可於石材表面塗上水玻璃溶液，待其乾燥後再塗抹氯化鈣水溶液，以形成不溶性保護膜

$$37. \frac{440 - 7.5 + 5}{20 + 1} \times \frac{300}{5.3 + 0.8} = 1024.6 \text{ 塊} \approx 1025 \text{ 塊}$$

$$38. (440 - 7.5 + 5) \times 300 = 131250 \text{ cm}^2 = 13.125 \text{ m}^2$$

$$1 \text{ m}^2 : 11 \text{ 才} = 13.125 : x \Rightarrow x = 144.375 \text{ 才} \approx 145 \text{ 才}$$

39. (C) 所謂軟玻璃與硬玻璃是指其受熱熔解的難易度，在較低溫度下可變為液態者稱之軟玻璃，反之則為硬玻璃
40. (A) 強化玻璃碎裂時會粉碎為小顆粒般大小而不尖銳的碎片
(B) 網線玻璃多用於防火、防盜、天窗等玻璃門窗
(C) 強化玻璃是於製造過程中利用熱處理的方式增強玻璃強度